Estimate of Energy and Cost Savings from Proposed IECC Code Changes for 2012

Prepared by ICF International for the Energy Efficient Codes Coalition (EECC)

Summary

The International Code Council (ICC) is hosting Code Development Hearings in Baltimore and will be hearing proposals and testimony on how to improve the International Energy Conservation Code (IECC).

ICF International, at the request of the Energy Efficient Codes Coalition (EECC), used an hourly energy simulation model to develop a preliminary estimate of the energy savings associated with the EECC's "package" proposal, EC25. Using the same comprehensive set of new home prototypes, ICF compared the savings from EC25 with a preliminary estimate of those from two other major packages proposed to the IECC, EC13 submitted by the Department of Energy (DOE) and EC16 submitted by the National Association of Homebuilders (NAHB).[1] For all three proposals, ICF estimated energy savings compared with the 2006 IECC, using annual energy costs for heating, cooling, hot water, and lighting as the main performance metric. In all three cases, the impact of the code proposals takes into account the savings from changes adopted in the 2009 IECC.[2] Other details of ICF's analysis methodology are presented at the end of this paper. ICF's estimates are summarized in the following table, and discussed in detail, below.

Table 1. Energy Savings Compared with the 2006 IECC[3]

Code Proposal	Annual Energy Cost Savings		Peak kW	AC Sizing
	National Average	Range by Climate Zone		
2009 IECC	12.9%	10.8-15.1%	7.1%	12.2%
EC25 (EECC)	30.3%	25.4-33.5%	18.6%	23.4%
EC13 (DOE)	25.4%	20-5-28.4%	12.3%	22.0%
EC16 (NAHB)	21.4%	16.0-25.3%	10.1%	19.2%

[1] ICF did not comprehensively estimate savings for a fourth package proposal, EC11, submitted by the Northwest Codes Council, due to the complexity of the multiple combinations with available time and resources.
[2] ICF International. 2009. "Energy & Cost Savings Analysis of 2009 IECC Efficiency Improvements." January. http://www.thirtypercentsolution.org/solution/EECC-Savings_Analysis-Jan-2009.pdf
[3] 2009 IECC estimated savings are updated with 2008 housing starts data and vary slightly from previous analysis.

EC25 Achieves Greater than 30% Savings over the 2006 IECC

The Energy Efficient Codes Coalition (EECC) has developed a series of proposals that will improve the 2012 IECC by more than 30% beyond the 2006 IECC. In addition to those proposals adopted in the 2009 code cycle, the heart of the new EECC proposals is EC25, a comprehensive solution estimated to improve the IECC by 30.3% beyond the 2006 IECC, based on ICF International's preliminary estimates for purchased energy used for heating, cooling, hot water, and lighting. EC25 is also estimated to reduce the peak demand on electric utilities by 18.6%, helping to save billions of dollars that would otherwise go to building new power production plants. EC25 is also estimated to reduce the size of air conditioning units by 29.9%, thus helping to reduce the cost of energy-efficient construction, and future costs by homeowners when they need to replace their air conditioning system.

Adopting EC25 along with several individual code changes proposed by or supported by the EECC would increase savings substantially beyond 30%.

EC13 Would Also Achieve Significant Energy Savings, beyond the Changes Already Adopted in the 2009 IECC

Similar to the EECC proposals, the Department of Energy (DOE) is also proposing to improve the IECC by a substantial amount. While ICF estimates that the DOE proposal, EC13, would achieve somewhat lower savings – 25.4% on a national basis – these savings could be increased if the IECC were to combine EC13 with several of the EECC's individual code proposals, to achieve the full 30% energy savings. EC 13 is also estimated to achieve a 12.3% reduction in peak electricity demand and a 22.0% reduction in the size of air conditioning units.

EC16 Does Not Achieve 30% Savings

The National Association of Home Builders (NAHB) has proposed a series of measures that would reduce the long-term energy efficiency of homes by creating trade-offs for short term features like HVAC to reduce the efficiency of the building envelope. NAHB's EC16 is estimated by ICF to achieve 21.4% energy savings, but much of those savings are in short-term features such as HVAC and light bulbs; the light bulb provision alone is responsible for more than 42% savings in lighting energy use. NAHB's proposal also would achieve lower reductions in electricity peak demand and require larger air conditioners than either the EECC or DOE proposals.

Some NAHB Proposals Reduce Energy Efficiency

Unlike the DOE and EECC package proposals, some of NAHB's proposals in its EC16 package include code language that will substantially reduce the efficiency of homes. This includes removing the requirement contained in both the 2006 IECC and the 2009 IECC for the performance path to use reduced window area in the reference home for homes with less window

area, like low-income housing. By removing the reduced window area requirement, a low-income home with 12% window area is estimated by ICF to be 1.7% less efficient with the NAHB proposal, and have more than a 5% increase in peak demand on the electric grid and in air conditioner size. Homes with less window area will see even a more substantial loss in energy efficiency.

Another element of the NAHB proposal would weaken the IECC 2009 by removing the requirement that the building envelope cannot be degraded by trading off long-term building envelope measures against shorter-lifetime improvements in HVAC efficiency. To achieve real, lasting energy savings, the lifetime of energy-efficient measures must be taken into account. The building envelope, which is far less expensive to upgrade during the construction of the home than as a later retrofit, offers the most important set of measures to achieve long-term energy savings.

If the IECC has a trade-off between short-life and long-life measures, builders could claim trade-off "credit" for high-efficiency furnaces, for example, by installing less insulation or less-efficient windows, even though such furnaces already account for some 40% of the U.S. market, and well over 50% of the market in colder states. This trade-off was eliminated from the performance path in the 2009 IECC for precisely this reason, since states are currently prohibited by statute from selecting a higher "baseline" HVAC system that is more representative of market conditions in the state.

By removing the requirement that the building envelope not be degraded with an equipment trade-off, the NAHB proposals allow for a 7% degradation of the building shell in a case where a 90% efficient furnace is installed in northern climates. Since this type of furnace is typically installed anyway, this amounts to a 7% loss in energy efficiency, likely for the life of the home. The degradation on the building envelope will also require that homeowners continue to pay for larger equipment through the life of the home and suffer discomfort due to a larger temperature difference between the space temperature and the temperatures of wall surfaces and windows. If other equipment upgrades, such as improved hot water heating or cooling, were also permitted as trade-offs as proposed by NAHB, the envelope degradation would be far worse.

Societal Benefits Add to the Direct Value of Energy Cost Savings to the Homeowner

Societal benefits of adopting EC13 and EC25 are substantial and could significantly influence public policy priorities such as:

- Increasing America's energy security by reducing energy imports and avoiding power shortages
- Reducing the need for expensive new power plant capacity to meet rising electricity demand
- Reducing emissions of greenhouse gases and other air pollutants
- Reducing or stabilizing energy prices for all Americans, by reducing energy demand in buildings

- Reducing the cost of building materials - moderating energy prices reduce materials manufacturers' energy costs and thus moderate future materials prices.

Modeling Methods and Assumptions Used in ICF's Analysis

ICF International has extensive experience with the use of hourly building energy simulation software to estimate energy performance and energy savings of alternative building codes and design concepts. Although the numbers included in the ICF analysis represent the best preliminary independent technical judgment by our staff, it should be kept in mind that – like any such analysis – the results depend on a number of assumptions about the physical features of a typical new home, operating practices, energy prices, the relative number of new home starts by climate zone and building type (e.g., single-family attached *vs* detached), and many other factors. The existing IECC and new code proposals themselves allow a builder to choose among a number of alternatives to comply with the code; another reason why energy savings can vary substantially even for code-compliant new homes.

In estimating the comparative savings for each of the package proposals (EC25, EC13 and EC16), ICF conservatively chose to compare the results from the prescriptive path option included in the proposal that saved the least energy cost since it is uncertain which path a user would choose. For example, since the NAHB proposal (EC16) has four alternative prescriptive paths, the results shown represent the least efficient path. The remaining paths vary significantly in estimated energy savings.

ICF uses Beacon™, an hourly simulation model that utilizes DOE-2 or EnergyPlus, and. summarizes building performance in terms of estimated annual energy costs, based on DOE/EIA state level energy costs. ICF also estimates energy consumption by end-use, fuel type, electricity peak demand, and air conditioner size in each prototype home. Beacon™ analyzes a broad array of house types, seeking to capture a reasonable representation of the varieties of home construction around the U.S. by modeling homes with the following range of characteristics and then calculating weighted averages based on the projected mix of housing starts:

- 239 TMY2 local climate locations in US
- Three types of foundations: slab, basement & crawl space
- Two building heights: One & two stories
- Two floor areas: 2,000 & 3,000 square ft.
- Energy Costs: 2008 Energy Information Agency utility rates by state
- Regional and national results reflect weighting by number of housing starts and baseline energy use

The ICF approach also makes the following assumptions regarding the baseline home:

- Three bedrooms
- R-Values, U-Values & SHGC from the 2006 IECC
- Home aspect (width : height) ratio of 2:1
- Insulation installation quality: Grade 3
- R-6 duct insulation
- Duct leakage: 15 CFM for each 100 square feet of conditioned floor area
- Air infiltration of 8 ACH50
- Lighting: 10% high efficacy lamps
- Window area: 15% of floor area
- Thermostat: 72° heating, 75° cooling

- Interior Shade Fraction: 0.85 winter, 0.70 summer
- HVAC system: 15% over-sized
- Furnace AFUE: 78%
- Air conditioner SEER: 13
- Heat pump HSPF: 7.7
- Water heater: 40-gallon gas with 0.594 EF
- Ducts located in unconditioned space:
  - 100% in 1-story, slab or crawlspace
  - 75% in 1-story, basement
  - 75% in 2-story, slab or crawlspace
  - 65% in 2-story, basement
- Frame Fractions: 23% wall, 11% ceiling and 10% floor
- Below-grade basement wall height: 6´
- Roof & wall absorptivity: 0.75
- Factors: Shielding =0.185; Horizontal = 0.40; Neutral level = 0.50

About ICF International

ICF International (NASDAQ: ICFI) partners with government and commercial clients to deliver consulting services and technology solutions in the energy, climate change, environment, transportation, social programs, health, defense, and emergency management markets. Since 1969, ICF has been serving government at all levels, major corporations, and multilateral institutions. ICF combines its expertise in energy policy, building science, and industry knowledge with its unique analytical capabilities to help clients successfully develop policies and programs. ICF has extensive experience assessing energy performance and savings for technologies and buildings. This experience ranges from providing simple assessments, such as spreadsheet calculations, to very detailed energy modeling simulations for the residential, commercial, and industrial buildings sectors. ICF also has extensive experience in creating sophisticated and easy to use software tools for clients to predict the energy and demand savings potential of their programs.

About the EECC

The Energy Efficient Codes Coalition is a unique, broad-based alliance of longstanding energy efficiency advocates that united to join a growing chorus supporting an ambitious step forward in the energy efficiency of American homes. Its supporters include government, national energy efficiency groups, regional energy efficiency alliances, environmental groups, utilities, affordable housing advocates, architecture, academia/think tanks, energy consumers and businesses, and labor. Together, in 2007/2008 the Coalition developed "The 30% Solution," a comprehensive code change proposal to boost energy efficiency in the 2009 model energy code by 30% over the current IECC, using fully achievable and affordable "state-of-the-shelf" technologies. The Coalition also opposes proposals that either weaken energy efficiency or include industry- or product-specific special exemptions.

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